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ABSTRACT

A successful Web-based training (WBT) system must be highly adaptable to already existing training procedures and software in a special environment. In corporate environments internal communication and collaboration is usually standardized throughout the company. The success of a WBT system therefore mainly depends on the ability of the system to utilize the well known communication channels instead of defining new ones. WBT users do not want to deal with new software; companies have their standardized software packages installed on most of their computers and very often do not allow the installation of new ones. These considerations led to the design of GENTLE (GEnerated Networked Teaching and Learning Environment) as a flexible WBT platform rather than a fully integrated software package. This paper demonstrates the concept and features of GENTLE and describes the modules that make up the GENTLE system. Also outlined are the three steps to performing an online discussion using the high-level online collaboration tools of GENTLE. (AEF)

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Beyond Over-Integration: GENTLE

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Abstract: In this paper we show that a good WBT platform has to provide structured courseware as well as good online and offline discussion features. Nevertheless it is not possible to fully integrate special online conferencing tools although they must be usable in a high level WBT environment. For this reason GENTLE, the implementation of the WBT system proposed here, utilizes the loose synchronization paradigm that is also discussed more in detail in this paper.

Introduction

Since web-based training (WBT) has been one of the big buzz-words throughout the last years there are many different opinions which features such a system should provide. Very often WBT is understood to simply consist of computer-based training (CBT) courses that are accessible via a Web server.

In our opinion a good WBT system needs to provide more than just courseware, it has to be a higly interactive, collaboarative system that fully utilizes the possibilities of today's networks. WBT users should be able to browse through the courseware, ask questions, make comments and discuss unclear points with the trainer or also with other WBT users [see also Skillicorn 96].

We are using the terms ``WBT user'' and ``trainer'' here instead of the widely used terms ``student'' and ``teacher'' because WBT systems are more and more used in corporate intranets rather than only in schools and universities. Considering the different environments it becomes clear that a successful WBT system has to be highly adaptable to already existing training procedures and software in a special environment. In corporate environments internal communication and collaboration is usually standardized throughout the company. The success of a WBT system therefore mainly depends on the ability of the system to utilize the well known communication channels instead of defining new ones. Also, WBT users do not want to deal with new software. Further, and even more crucial companies have their standardized software packages installed on most of their computers and very often do not allow to install new ones.

These considerations led to the design of GENTLE (GEneral Networked Teaching and Learning Environment) as a flexible WBT platform rather than a fully integrated software package [see also Maurer98]. In the following section we will point out the requirements and the resulting concept of the system implemented.

The Concept of GENTLE

The point that we found to be most important for the acceptance of the system was that access to GENTLE has to be possible using standard Web browsers such as Netscape Navigator or MS Internet Explorer. Without having any other software package beyond a Web browser installed WBT users have to be able to navigate through the courseware material and must have the possibility to make notes as well as to take part in offline discussions.

For this reason we are using Hyperwave [see Maurer 96] as the server platform for GENTLE since it already provides many of the features needed:

- **Structured information space:** The courseware in the system as well as annotations and discussion groups have to be hierarchically structured to allow easy navigation through the system. Since Hyperwave allows that single documents can be members of more than one part of the hierarchy this feature also allows to define different views for different users and user groups. Consider for example two WBT users taking a course on

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Java. One of them is already an experienced programmer while the other is rather a newbie. The newbie will need much more explanatory material about basic programming paradigms that would be disturbing for the expert. On the other hand most of the material directly dealing with Java will basically be the same. Instead of preparing the course twice Hyperwave allows it to share the material of a comprehensive course covering basic and expert knowledge and just hide the basics from the expert.

- **User and group management with profiles:** Again taking the example above the system has to provide the possibility for the users to define their interests, special skills, etc. so that the system can automatically provide the desired view of a course. To achieve this Hyperwave's user and group management features come into play. Users can easily define their skill levels as well as personal interests and store them in their user profile. Together with Hyperwave's clustering features they are then presented exactly with the view of the course that matches their profile. Another benefit is that users can change their view of the system on the fly by adapting their preferences.
- **Annotation facilities:** Hyperwave supports insertion of annotations to documents for authorized users. This feature can be used for inserting notes to parts of the courseware into the server. These notes can themselves be annotated again leading to an offline discussion. Annotations themselves can have special types such as question, answer, agree, disagree and arbitrary others. The types themselves can be visualized by little icons and therefore users can choose to follow a discussion thread without having to read all the messages to find out the author's point of view. Besides publicly visible annotations it is also possible to insert private annotations into the system. Private annotations allow WBT users to make notes for themselves without disturbing other users or being subject of discussions. With private annotations WBT users can even build up their personal view of the courseware that can even be made up of parts of several different courses.
- **Automatic CD-ROM creation:** Hyperwave supports automatic creation of CD-ROMs from parts of the information hierarchy. This feature can be used for archival purposes, however CD-ROMs can also be made for WBT users that want to study their courses at home and have no permanent internet connection. Such CD-ROMs can be used for mere offline courses without the collaboration and discussion facilities, but they also contain the pointers to the discussion areas on the server. If WBT users are taking the CD-ROM home for studying offline and if they have an internet connection at home they can also decide to insert annotations directly from the offline CD-ROM without having to leave their course in order to reconnect to the public server.

In addition to the offline features discussed above very strong emphasis has been put on online communication between WBT users and trainers as well as group discussions. This is also exactly the point where full integration of all possible features into one system becomes more or less infeasible. Just imagine to re-implement all the software for audio- and videoconferencing used at the moment for the sake of integration! There are many different standards existing for audio conferencing, video conferencing and whiteboards, just to mention the most widely used online communication facilities. Some of them rely on high-bandwidth MBone connections, some of them use standard IP connections, some are commonly used for low quality communication such as Netmeeting, etc. Also different proprietary high quality (and expensive!) teleconferencing systems are in use in corporate networks. Very often it is not even possible to integrate the systems because they are using special protocols that are not public knowledge, even worse, some systems are based on special hardware.

These considerations led us to the point already stated above: GENTLE has to serve as a universal platform supporting the other systems rather than trying to fully integrate them. To be able to support the different standards easy to use synchronization mechanisms had to be found. Since these synchronization mechanisms have to be an integral part of the WBT system available on every single platform and in all different environments our choice was to use email and a simple Java chat applet. Even when execution of Java applets in the Web Browser is not allowed in a corporate environment (which is often the case!) email is a basic communication feature available everywhere. The Java chat applet is then the more sophisticated online solution for environments that allow its execution.

Let us now consider an example how an online discussion about a certain topic in the courseware can take place using a proprietary high quality video conferencing system and a whiteboard: WBT users that find out that they need clarification of a certain topic for deeper understanding simply click on a button establish discussion session in their Web browser. A dialog pops up and the users can choose with who to discuss this, e.g. the trainer, other WBT users or a certain predefined group of persons. This dialog also automatically determines the part of the courseware that is currently loaded. Further, users can also choose when to discuss the topic: either immediately, which implies that the

discussion partners need to have their Java chat applet running so that they can be informed online, or later at a certain time.

If immediate discussion is chosen and the discussion partners are online a text chat session is opened and the initial message that a user wants some online discussion about the previously determined topic is sent to all partners. The partners can now all open their video conferencing tools and whiteboards and start the discussion.

The other case that either the use of the Java chat applet is not permitted or the discussion partners are not online for chat at the moment results in automatically sending an email to the partners that some discussion should take place for example at 3:00 pm the next day. If desired the system can also automatically post an announcement about the topic and time of the discussion in the courseware communication section so that everybody who is interested can also take part in the discussion. At the desired time all the partners can then open their video conferencing tools and whiteboards and start the discussion as stated above.

When a discussion session is already established further synchronization (if not already integrated in the special tools) can again take place using either the Java chat applet or email. Something like e.g. ``please open the page at URL so and so'' can easily be sent to the partners.

Using this loose synchronization paradigm all the features of highly specialized conferencing tools can be obtained in the WBT environment without having to integrate them. In environments where GENTLE is installed the users can themselves agree on certain tools to be used and do not have to leave their well-known environments. New developments in this area can easily be used without having to do the whole integration work for the system.
In addition to tool integration by loose synchronization we identified two other very important features that the system has to provide: intelligent helpers and basic user agents. Intelligent helpers provide the ability to monitor the users and store the data collected in the user profiles. User monitoring can take place by either using questionnaires from time to time or by evaluating the kind of help users need. If for example users very often require help about basic system features such as ``where do I click to go to the study room'' the intelligent helper will deduce that the user is new to the system.

Evaluation of the monitoring data give the users feedback about their skills and can also be used to automatically generate different views of the system depending on the users' skills as has already been discussed above. Different views does not only mean different views of the courseware but also different levels of help. Users that are new to the system will get more general help on how to use the system than experienced ones. The longer (and more often) users work with the system and the fewer basic questions they ask the less basic hints they will obtain. Instead, help will provide more hints about advanced system features. The result is that WBT users do not only learn their courseware but also implicitly learn more about the system itself in a very natural way.

Basic user agents in GENTLE are easy to configure helpers that run on the server side. Their tasks are to make the users' lives easier when looking for new information. For example users can have an agent in the system informing them automatically whenever new courseware on a topic is inserted in the server. Another feature should assure that users be informed automatically whenever a discussion session on a certain topic takes place (if the discussion is not private!).

After discussion of the basic concepts of GENTLE the following sections will deal more in detail with the implementation of the system.

The Structure of GENTLE

As has already been discussed the core of GENTLE is a Hyperwave server providing all the basic features needed for implementation of the WBT platform scenario developed. The whole system is divided into the following modules:

- Courseware structure management
- WBT user registration management
- Personal profile management

- Personal study room management
- Offline discussion area management
- Online discussion announcement management
- Shared bookmark management

These modules make up the basic integral system functionality of GENTLE as a flexible WBT platform. They also prepare the way to use highly specialized software using the loose synchronization paradigm. In what follows, the tasks of the single modules are described in more detail. Again we want to mention here that no additional software except a standard Web browser is necessary to perform the tasks discussed below.

Courseware Structure Management

As has already been mentioned courseware has to be structured in an easy to navigate hierarchy [see also Maglajlic 98]. Providing a good structure also results in the possibility to provide different views of the system for different users and user groups. GENTLE allows courseware to be prepared in every desired format and is not limited to e.g. HTML pages or even worse to some special proprietary format. Trainers can choose the software most suitable for their courses. The only point that has to be considered is which software is installed on the WBT users' computers. Mostly this is again a corporate decision because some software has already been internally used for a long time.
Courses in GENTLE can now be structured in several different ways in parallel and the WBT users are then automatically provided with the view best suitable for their skills. First of all single courses are divided into sections and knowledge areas. Second all the parts that make up the course are categorized by the skill levels that WBT users shall have to see these parts. Third additional material and cross-references to other courses or parts of them are also inserted in the hierarchy, again with the necessary users' skill levels. The skill level categorization of the courseware is then used in combination with the personal user profiles to determine which parts to present to a certain user.

WBT User Registration Management

New users in GENTLE can be registered in either of two ways:

- **Automatic user registration:** If this mode is allowed by the system operators users can themselves create a WBT user account on the system, register their desired username, password, email and other desired data. These users then initially get the rights to read certain areas of the courseware and take part in some of the discussion areas as defined by the system administrators. Registration is simply performed by filling out an HTML form.
- **Centralized user registration:** Again users fill out a simple HTML form with all their data. Instead of automatically registering the users and giving them initial rights the data is sent to the system administrator. The administrator then either accepts or rejects the registration and defines the initial rights of the certain WBT user.

Once WBT users are registered they also get their personal profiles and their personal study rooms for their work.

Personal Profile Management

Personal profiles exist for all registered WBT users. In the personal profiles two kinds of datasets are stored:

- Personal data such as the real name, email address, etc. that need to be known by others to get in contact with them. Also special access rights, group memberships and other administrative data is stored here. The system administrators decide which part of the personal user data is accessible for users and which part is private.
- Personal preferences to be evaluated by the system. The preferences contain the users' experience and skill levels as well as all other statistical data collected by the helpers. Also contained are the agents that the users have installed together with their parameters. Besides and very important the preferences also contain information about all loosely synchronized tools that certain users are wanting to use for online discussion such as the kind of video-conferencing software, the whiteboard, etc. With this information the system can decide automatically if a request for discussion can be satisfied and the system can also automatically choose the way to loosely synchronize communication (e.g. to use email or the Java chat applet).

Personal Study Room Management

As has already been mentioned all WBT users obtain their personal study room. This is the main environment for WBT users that they see when working with the system. The personal study room provides all the navigational features as well as all administrative features accessible to the users such as profile, helper and agent management, personal business cards and more.

In the study room WBT users also always get a dynamic overview of actually enroled and already finished courses as well as suggested courses according to their interests and skills.

If allowed by the system administrators WBT users also can get a limited amount of space on the server. This space can for example be used to upload additional material into their personal workspace in the study room. If desired WBT users can also declare parts of their personal workspace publicly readable if they want to publish special additional material to a course.

Another part of the study room is a basic personal messaging system that works similar to email but via the courseware server. Using this messaging system WBT users and teachers can communicate with each other and manage their message space as can be done with email. The advantage of this messaging system compared to email is the availability on the server. Users can quickly read and write messages from everywhere without needing access to their email system. This feature is especially important for trainers that are travelling a lot and do not want to scan all their email from somewhere in the world to find out about new questions asked.

Offline Discussion Area Management

Two different offline discussion facilities are part of GENTLE, offline discussion forums and personal messaging which has already been discussed above. Offline discussion forums are structured according to their topics and are usually belonging to certain courses. Depending on their course access rights WBT users have access to certain forums and can insert questions, notes or opinions.

As an example students could find an unclear formulation in the courseware and want to clarify that point. In this case they only have to mark the unclear text area and a simple click on a button in the course environment of their personal study room opens a dialog. The dialog automatically maintains a pointer to the marked unclear section and lets the users write some text. Besides also the type of discussion entry can be selected, at the moment question, answer, agree, disagree, remark and hint are supported. Then the whole entry with the pointer to the unclear section is inserted into the discussion forum. Besides also an email message is sent to the trainer to alert him of the new entry if desired. The trainer then opens the forum, finds the new entry and immediately sees due to the special icon that this is for example a question. When opening the question the trainer obtains the question text together with the automatically generated pointer to the unclear section in the courseware. Now the trainer can answer the question in the same way the WBT user asked it and the answer is inserted into the forum and automatically interlinked with the question. The answer itself can then be subject to new questions or remarks and so forth resulting in an offline discussion. Discussions need not be publicly accessible, WBT users as well as trainers also have the possibility to declare entries private which means that only the persons involved in the discussion can read them.

Shared Bookmark Management

Experience with WBT systems has shown that many users search the Web for additional information and store interesting pages in their client-side bookmark files. The result is that all the users have to do a lot of work to find partially overlapping material. For this reason GENTLE also provides a facility to maintain bookmarks that are shared amongst WBT usergroups. Whenever WBT users find an interesting document they can simply click on a button in their environment that opens a shared bookmark dialog. In this dialog they can mark the usergroup for which the pointer is interesting and insert the URL that they found with some additional description. Other users being members of this workgroup then find the interesting entry the next time they look into the group document. It is also possible to install a user agent that automatically informs the group members of new entries in the shared bookmarks via email.

Online Discussion Announcement Management

As has already been discussed in the overall system concept arbitrary online discussion tools such as high-level videoconferencing software or shared whiteboards can be used together with the GENTLE with loose synchronization. One possibility to establish an online discussion is to post a message in an announcement forum with a call for participation in a conference at a given time.

The online discussion announcement forum is managed similarly to the offline discussion forum. Users can open a dialog from within their study room, write a call for an online conferencing session and give it a topic and a type. Besides the desired members and usergroups for this conferencing session are selected as well as the session is marked to be a public or a private session. This call is then inserted in the discussion announcement forum readable only for the desired group of persons. Besides all conferencing partners are automatically informed of the call via email.

The partners receiving a call for discussion then have the possibility to agree to this call or for example propose a different time for the session. This proposal is then also sent to all the partners and posted in the forum. Discussion then goes on until all participants have agreed.

If the session is declared to be a public session the final announcement is also made readable for everyone while all previous discussion entries remain private to the participants. WBT users who have an agent in the system looking for public conferencing sessions on certain topics are then also automatically informed of this event.

Loosely Synchronized Online Collaboration Features

Although all the offline features of GENTLE already make it a very powerful WBT platform the concept of loose synchronization is the biggest step towards the future of WBT systems. The idea is simple but effective: trainers and WBT users agree on the high-level collaboration tools that they want to use together with GENTLE. All users of the system have profile entries with the tools that they are able and willing to use for collaboration, e.g. videoconferencing systems, whiteboards, etc.

Performing an online discussion using the high-level online collaboration tools is then done in three steps:

- **Call for online discussion:** As has already been described GENTLE manages online discussion announcements. When posting a call for discussion the callers are able to select the tools that they want to use and the system automatically looks up the profiles of the participants to find out whether they all support the desired software. If not the system returns with a proposal of different possibilities.

  The system also looks up the loose synchronization mechanism supported by the participants and decides whether online chat can be used or whether synchronization has to take place by simple email. All information about the tools and the synchronization is automatically included in the call.

  Discussion about the call until the final agreement is then performed using the strategy mentioned in the previous section.
- **Establishing an online discussion session:** At the agreed time all participants open their collaboration tools and start the session. In parallel they also have their Web browsers open and depending on the agreed synchronization mechanism open the automatic email or online chat dialog.
- **Synchronization of users during online discussions:** During a discussion session either the automatic email or the online chat dialog are used for synchronizing context switches. For example if partners wants to switch to a different page in the Web browser they simply copy their desired URL into the synchronization dialog. Depending on the agreed mechanism this dialog then either sends a message to the online chat system or delivers this message via email to all the partners in the session. As soon as all the partners received the message they simply navigate to the desired location and acknowledge the receipt of the message in the synchronization dialog. Again this acknowledgement is either delivered as a chat message to the initiator or sent back as email.

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